

(43) International Publication Date  
9 June 2005 (09.06.2005)

PCT

(10) International Publication Number  
WO 2005/052573 A1(51) International Patent Classification<sup>7</sup>: G01N 33/18, 1/00

[GB/GB]; 17 Alderley Road, Urmston, Manchester M41 5DW (GB).

(21) International Application Number:

PCT/GB2004/004728

(74) Agents: NEILL, Alastair, William et al.; Appleyard Lees, 15 Clare Road, Halifax HX1 2HY (GB).

(22) International Filing Date:

8 November 2004 (08.11.2004)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

0326659.0 15 November 2003 (15.11.2003) GB

(71) Applicant (for all designated States except US): IN-  
TELISYS LTD [GB/GB]; Campus Ventures Centre,  
Oxford Road, Manchester M13 9PL (GB).

(72) Inventor; and

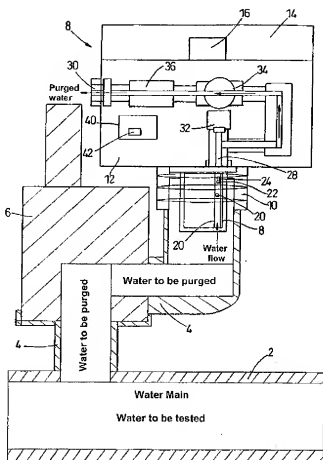
(75) Inventor/Applicant (for US only): BOYD, Nathan

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MY, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: FLUID MONITORING APPARATUS AND METHOD



(57) Abstract: A fluid monitoring apparatus for monitoring a fluid in a fluid mains supply, the apparatus comprising means for connecting the apparatus to the mains supply, a testing chamber, a fluid tester, testing a variable of a fluid in the testing chamber and a purger for purging a volume of fluid from the testing chamber which volume of fluid is substantially larger than the volume of the testing chamber, thereby replacing the fluid in the testing chamber with a new fluid volume.

## FLUID MONITORING APPARATUS &amp; METHOD

Field of the Invention

5 The present invention relates to fluid monitoring apparatus and particularly, though not exclusively, to mains water monitoring apparatus. The present invention also relates to fluid mains, especially but not exclusively water mains, to which such an apparatus is  
10 coupled. The present invention also relates to fluid monitoring methods.

Background to the Invention

15 Mains water supplies need to be monitored for the well-being of the populous and to assist in the maintenance and upkeep of those supplies. Monitoring of such supplies up to now has been carried out by local inspection. A human operative will visit a mains hydrant,  
20 gaining access thereto by a culvert or the like, collect a sample of mains water from the hydrant branch and move on, returning periodically.

This has several disadvantages. It is intensive in terms  
25 of skilled manpower requirements and only tests water in the hydrant branch. Further, for many forms of monitoring water needs to be removed from the location for testing as a result of which its properties may change.

30 It is an aim of preferred embodiments of the present invention to obviate or overcome a disadvantage of the prior art, whether such disadvantage or prior art is referred to herein or otherwise.

Summary of the Invention

According to the present invention in a first aspect,  
5 there is provided a fluid monitoring apparatus for monitoring a fluid in a fluid mains supply, the apparatus comprising means for connecting the apparatus to the mains supply, a testing chamber, a fluid tester, testing a variable of a fluid in the testing chamber and a purger  
10 for purging a volume of fluid from the testing chamber which volume of fluid is substantially larger than the volume of the testing chamber, thereby replacing the fluid in the testing chamber with a new fluid volume.

15 Thus fresh fluid can be tested.

Suitably, the apparatus is suitable for coupling to a hydrant connected to the mains supply.

20 Suitably, the apparatus comprises a purge controller for controlling the purger to determine the volume to be purged. Suitably, the apparatus comprises a pressure sensor for measuring the fluid pressure. Suitably, the purge controller uses the measured pressure to determine  
25 the period for which the purger should operate. Suitably, the period is determined by comparing the pressure in a look-up table for a suitable purge time. Suitably, the purge controller comprises a microprocessor.

30 Suitably, the purger is configured to act for a purge time such that the fluid from the mains supply enters the testing chamber.

Suitably, the fluid tester comprises a turbidity tester. Suitably, the apparatus comprises an electrical conductivity tester. Suitably, the apparatus comprises a temperature tester.

5

Suitably, the apparatus is configured whereby purged fluid is purged from the apparatus to atmosphere.

Suitably, the apparatus comprises a memory for storing  
10 fluid test information. Suitably, the apparatus comprises means to enable data from the memory to be downloaded to an external device.

Suitably, the apparatus comprises a power cell.

15

Suitably, the fluid comprises a liquid. Suitably, the liquid comprises water.

Suitably, the mains supply is a mains water supply.

20

According to the present invention in a second aspect, there is provided a fluid mains to which an apparatus according to the first aspect of the present invention is coupled.

25

Suitably, the fluid mains is a liquid mains.

Suitably, the liquid mains is a water mains.

30 According to the present invention in a third aspect, there is provided a method of operating a fluid monitoring apparatus for monitoring a fluid in a fluid mains supply, which method comprises the steps of connecting the

apparatus to a mains supply, testing a variable of a fluid in a testing chamber and purging a volume of fluid from the testing chamber which volume of fluid is substantially larger than the volume of the testing chamber, thereby  
5 replacing the fluid in the testing chamber with a new fluid volume.

#### Brief Description of the Drawings

10 The present invention will now be described, by way of example only, with reference to the drawings that follow; in which:

Figure 1 is a perspective illustration of an apparatus  
15 according to the present invention attached to a hydrant.

Figure 2 is a schematic cross sectional elevation of the apparatus shown in Figure 1.

20 Figure 3 is a schematic perspective view of a turbidity sensor for use in the apparatus show in the preceding figures.

#### Description of the Preferred Embodiments

25 Referring to figures 1 and 2 of the drawings that follows, there is shown a mains water supply 2 (as an example of a fluid mains) from which extends a hydrant branch 4 to a hydrant 6. The hydrant branch 4 can be up to one metre  
30 long in practice (though the present invention is not limited to this or any other length).

Coupled to and mounted on the hydrant 4 is a fluid monitoring apparatus 8 according to a preferred embodiment of the present invention. In this case, the fluid monitoring apparatus is a water monitoring apparatus. The  
5 monitoring apparatus 8 is attached to the hydrant stand-pipe screw thread (not shown) by connection means comprising a thread attachment (indicated schematically at 10), which is secured to a case 12 of the apparatus 8 closed with a lid 14. The lid 14 is secured to the case  
10 by an attachment nut 16. Extending from the thread attachment and partially into the branch 4 is a sensor head 18 defining therein a testing chamber 20 into which water from the mains 2 flows. For the purpose of the present invention the hydrant branch 4 extends from the  
15 mains supply 2 to the entrance to the testing chamber 20.

The sensor head 18 carries turbidity, electrical conductivity and temperature sensors 20, 22, 24 respectively. These are fluid testers.

20

Referring to Figure 3 of the drawings that follow, turbidity sensor 20 measures turbidity by using a nephelometric turbidity cell 40, which measures scattered light at 90° to the emitter with the intensity of the  
25 reflected light being proportional to the concentration of particles within the sample. An infra-red light emitting diode (not shown) is mounted behind one of the sapphire glass windows 42, 44 and a corresponding detector (not shown) behind the other window 44, 42. This allows, a  
30 resolution and accuracy at the lower end of the scale ( 0-10 Nephelometric Turbidity Unit (NTU) ).

Electrical conductivity is measured to indicate the presence or absence of salts, and is often used as a surrogate measure for the dissolved load within a solution. The electrical conductivity sensor 22 (see also  
5 Figure 3) uses four-pole probes giving a linear output allowing for easier calibration. To some extent, such a sensor self-compensates for algal and particle fouling on the plates ensuring a low drift. For instance this can be a K25 sensor from Sentek Ltd, Braintree, Essex, United  
10 Kingdom.

The temperature sensor 24 is a high accuracy thermistor encapsulated within the electrical conductivity sensor 20.

15 From the sensor head 18 a fluid flow path 28 is defined to an outlet 30. In a branch of the main fluid flow path 28 there is located a pressure sensor 32. Part of the flow path is defined by a solenoid valve 34 and another part by a non-return valve 36 before the outlet 30. The outlet 30  
20 opens to atmosphere.

The apparatus further comprises a battery powered cell 38 for powering the apparatus 8.

25 Also provided is a microprocessor controller 40 and associated memory 42, which controller 40 receives signals from the sensors 20, 22, 24, and controls the solenoid valve 34.

30 Referring in particular to Figure 2, it is noted that in the branch 4 and the fluid flow path 28 of the apparatus 8 there is a substantial volume of water. In practice this

water may not have the same characteristics as the water in the mains supply.

A mode of operation of this embodiment of the present invention will not be described.

Controller 40 controls the apparatus 8 to sample the water in the mains supply 2 periodically, say daily. Apart from when carrying out fluid monitoring the apparatus 8 is dormant and has no material effect on the mains supply 2. When the controller 40 determines a test is to be carried out to monitor the water it receives a signal from the pressure sensor 32 indicative of the water pressure and from a look-up table stored in memory 42 determines a time for which the solenoid valve 34 needs to be open in order to purge sufficient water through the apparatus 8 so that the water in the sensor head 18 is mains water. Thus the solenoid valve 34 acts as a purger and controller 40 as a purge controller. That is, all of the water from the testing chamber 20 back to the water mains 2 has to be purged. The actual purge time required based on the current pressure can be determined empirically.

The controller 40 then controls the solenoid valve 34 to be opened for the period determined from the look-up table thereby to purge water through the apparatus 8 to atmosphere via the outlet 30. The solenoid valve 34 is then closed and readings are taken of turbidity, electrical conductivity and temperature from the respective sensors 20, 22, 24. These are then stored in the memory 42 associated with the microprocessor controller 40.

To download information from the microprocessor 40, a data outlet (not shown) can be provided or the apparatus can be BLUETOOTH enabled. In either case the data can be collected by an unskilled operative using a Personal  
5 Digital Assistant (PDA) or other data logging device. Modem and radio links can also be used.

The apparatus described herein can be used as a fluid testing apparatus, but is of particular benefit for  
10 liquids, especially water.

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and  
15 which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification  
20 (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same,  
25 equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each  
30 feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any  
5 accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

## Claims

1. A fluid monitoring apparatus for monitoring a fluid  
in a fluid mains supply, the apparatus comprising  
5 means for connecting the apparatus to the mains  
supply, a testing chamber, a fluid tester, testing a  
variable of a fluid in the testing chamber and a  
purger for purging a volume of fluid from the testing  
chamber which volume of fluid is substantially larger  
10 than the volume of the testing chamber, thereby  
replacing the fluid in the testing chamber with a new  
fluid volume.
2. A fluid monitoring apparatus according to claim 1, in  
15 which the apparatus is suitable for coupling to a  
hydrant connected to the mains supply.
3. A fluid monitoring apparatus according to claim 1 or  
claim 2, in which the apparatus comprises a pressure  
20 sensor for measuring the fluid pressure.
4. A fluid monitoring apparatus according to any  
preceding claim, in which the apparatus comprises a  
purge controller for controlling the purger to  
25 determine the volume to be purged.
5. A fluid monitoring apparatus according to claim 4, in  
which when dependent on claim 3, the purge controller  
uses the measured pressure to determine the period  
30 for which the purger should operate.
6. A fluid monitoring apparatus according to claim 5, in  
which the period is determined by comparing the

pressure in a look-up table for a suitable purge time.

7. A fluid monitoring apparatus according to any one of  
5 claims 4 to 7, in which the purge controller comprises a microprocessor.

8. A fluid monitoring apparatus according to any  
preceding claim, in which the purger is configured to  
10 act for a purge time such that the fluid from the mains supply enters the testing chamber.

9. A fluid monitoring apparatus according to any  
preceding claim, in which the fluid tester comprises  
15 a turbidity tester.

10. A fluid monitoring apparatus according to any  
preceding claim, in which the apparatus comprises an  
electrical conductivity tester.

20 11. A fluid monitoring apparatus according to any  
preceding claim, in which the apparatus comprises a temperature tester.

25 12. A fluid monitoring apparatus according to any  
preceding claim, in which the apparatus is configured whereby purged fluid is purged from the apparatus to atmosphere.

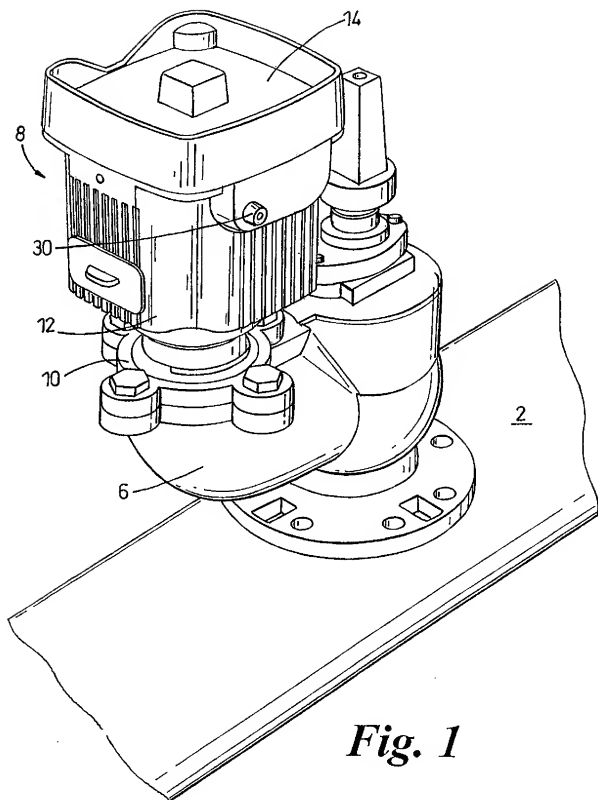
30 13. A fluid monitoring apparatus according to any  
preceding claim, in which the apparatus comprises a memory for storing fluid test information.

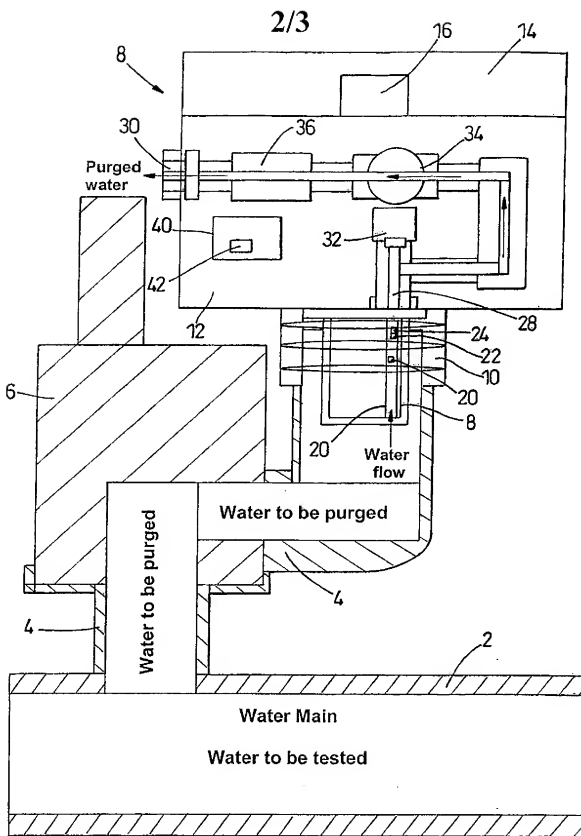
14. A fluid monitoring apparatus according to claim 13, in which the apparatus comprises means to enable data from the memory to be downloaded to an external device.
- 5 15. A fluid monitoring apparatus according to any preceding claim, in which the apparatus comprises a power cell.
- 10 16. A fluid monitoring apparatus according to any preceding claim, in which the fluid comprises a liquid.
- 15 17. A fluid monitoring apparatus according to claim 16, in which the liquid comprises water.
18. A fluid monitoring apparatus according to any preceding claim, in which the mains supply is a mains water supply.
- 20 19. A fluid mains to which an apparatus according to any one of claims 1 to 18 is coupled.
- 25 20. A fluid mains according to claim 19, in which the fluid mains is a liquid mains.
21. A fluid mains according to claim 19 and claims 20, in which the liquid mains is a water mains.
- 30 22. A method of operating a fluid monitoring apparatus for monitoring a fluid in a fluid mains supply, which method comprises the steps of connecting the apparatus to a mains supply, testing a variable of a

fluid in a testing chamber and purging a volume of fluid from the testing chamber which volume of fluid is substantially larger than the volume of the testing chamber, thereby replacing the fluid in the testing chamber with a new fluid volume.

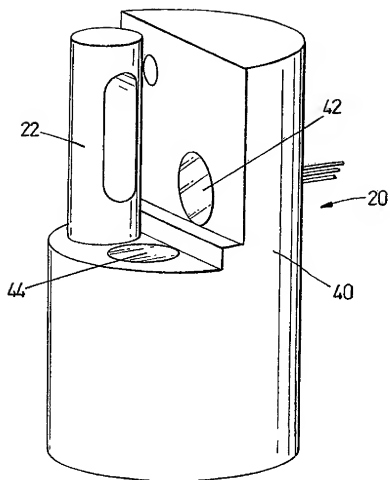
5

1/3



*Fig. 2*

3/3

*Fig. 3*

## INTERNATIONAL SEARCH REPORT

PCT/GB2004/004728

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 G01N33/18 G01N1/00

According to International Patent Classification (IPC) or to both national classification and IPC:

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 336 794 A (AEROSPATIALE SOCIETE NATIONALE INDUSTRIELLE) 11 October 1989 (1989-10-11) column 1, line 55 - column 2, line 21	1,2,9,22
Y	column 3, line 15 - line 25 column 3, line 42 - column 5, line 53; figures 1-3	3-8, 10-21
Y	US 2002/011266 A1 (GARVER THEODORE M ET AL) 31 January 2002 (2002-01-31) paragraphs '0092!', '0094!'; figure 6	3-8, 10-21
A	US 6 021 664 A (GRANATO ET AL) 8 February 2000 (2000-02-08) column 4, line 27 - column 5, line 50 column 11, line 60 - column 12, line 33; figure 7	1-22
	----- -/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

## \* Special categories of cited documents:

\*A\* document defining the general state of the art which is not considered to be of particular relevance

\*E\* earlier document but published on or after the international filing date

\*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

\*O\* document referring to an oral disclosure, use, exhibition or other means

\*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

\*S\* document member of the same patent family

Date of the actual completion of the international search

31 January 2005

Date of mailing of the international search report

09/02/2005

Name and mailing address of the ISA

European Patent Office, P.B. 5018 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Wulveryck, J-M

## INTERNATIONAL SEARCH REPORT

PCT/GB2004/004728

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 400 137 A (WINSLOW ET AL) 21 March 1995 (1995-03-21) column 2, line 69 - column 3, line 22 -----	1,22
A	US 3 492 946 A (STERLING T. MARTIN) 3 February 1970 (1970-02-03) the whole document -----	1,9,22

## INTERNATIONAL SEARCH REPORT

Information on patent family members

PCT/GB2004/004728

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0336794	A	11-10-1989	FR 2628533 A1 DE 68902258 D1 DE 68902258 T2 EP 0336794 A1 ES 2034661 T3	15-09-1989 03-09-1992 04-02-1993 11-10-1989 01-04-1993
US 2002011266	A1	31-01-2002	CA 2216046 A1 US 6263725 B1 AU 770180 B2 AU 4591002 A CA 2390002 A1 EP 1267154 A1 AU 9148298 A AU 9148598 A BR 9812337 A BR 9812651 A CA 2304199 A1 CA 2304201 A1 WO 9914577 A1 WO 9914591 A1 DE 19882993 T0 DE 19882996 T0 FI 20000604 A FI 20000605 A GB 2354581 A ,B GB 2355072 A ,B ID 25918 A ID 25722 A NO 20001327 A NO 20001357 A US 6134952 A	18-03-1999 24-07-2001 12-02-2004 12-12-2002 11-12-2002 18-12-2002 05-04-1999 05-04-1999 19-09-2000 22-08-2000 25-03-1999 25-03-1999 25-03-1999 03-01-2002 11-07-2002 10-05-2000 10-05-2000 28-03-2001 11-04-2001 09-11-2000 02-11-2000 18-05-2000 18-05-2000 24-10-2000
US 6021664	A	08-02-2000	NONE	
US 5400137	A	21-03-1995	NONE	
US 3492946	A	03-02-1970	NONE	